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<i>Oplismenus hirtellus</i> subsp. <i>imbecillus</i>		
<i>Phormium tenax</i>	harakeke, flax	Locally abundant
<i>Poa anceps</i>		Coastal slopes
<i>Rhopalostylis sapida</i>	nikau	Occasional in broadleaf forest patch
<i>Rytidosperma racemosum</i>	danthonia grass	
<i>Thelymitra</i> aff. <i>longifolia</i>	sun orchid	Locally common on slips
<i>Uncinia uncinata</i>		Local in broadleaf forest patch

Appendix Two

Bird species identified from Aiguilles Island 18TH to 22ND October 1999 by Phil Todd.

House sparrow	Blue penguin (Korora)
Silvereye (Tauhou)	Myna
Kingfisher (Kotare)	White-backed magpie
Morepork (Ruru)	Yellow hammer
Welcome swallow	Chaffinch
Reef heron (Matuku moana)	Warbler (Riroriro)
Harrier hawk (Kahu)	Southern blacked gull (Karoro)
Pied shag (Karuhiruhi)	Grey faced petrel (Oi)

The Flora of "The Grotto": a volcanic collapse pit on the lower slopes of Onehunga, Auckland

Timothy J. Martin

Introduction

"The Grotto" is a volcanic collapse pit situated on the lower slopes of Onehunga, Auckland. The steep sides of the pit, which is approximately 60 m across, are largely covered in low Chinese privet (*Ligustrum sinense*) forest. A wetland with a few small pools covers the floor. The area is not signposted and there are no buildings on the land. Local children use "The Grotto" as a wilderness playground, exploring its forests and caves.

The flora of "The Grotto" (refer to Appendix 1. Species List) was compiled from over 13 visits between July 2002 and November 2003.

Location

"The Grotto" lies between street numbers 26A and 40 on the northern side of Grotto Street. The area is a short distance uphill from the spring and wetland at Captain Springs Reserve, the flora of which has been described by Gardner (1994) and Beever (1994).

Geology and soils

Searle and Mayhill (1981) referred to two volcanic collapse pits in the area, the aforementioned "The Grotto", and "The Pond" which I have been unable to locate. Collapse pits are formed when dammed lava flows are rapidly released. This causes the underlying lava to flow away and the unsupported solid crust collapses. Sunlands in the Onehunga – Te Papapa – Penrose area originated from the Mount Smart

eruptions, which along with the Mount Wellington and One Tree Hill volcanoes form the Manukau lava field. The date of the Mt Smart eruption is difficult to place but the order of deposits show that it was the oldest eruptive centre in the Manukau lava field. Sunlands are also present in the Auckland region near Morningside (Searle and Mayhill 1981). The steep sides of the pit are vertical in places with areas of exposed basalt. Two caves are present on the south and western sides, the largest cave being c. 1 m wide by 4 m long.

The soils surrounding the pit are a volcanic-derived well drained loam. The floor of the pit is described by Kermode and Searle (1966) as being undifferentiated alluvium. Further investigation revealed the alluvium to be a form of sedge peat (Peter de Lange *pers. comm.* 2002).

Historical background

A 1959 aerial photograph shows several buildings on the flat land to the south east of the collapse pit (Fig. 1). All that remains of these buildings today are their concrete and brick foundations. The photograph also shows a low brick wall that is still present, cutting across the north and east sides of the wetland. The amount of vegetation has increased in the last 40 years, with an expansion of the forest on the south and west sides of the pit. Two *Acer* trees in the middle of the collapse pit are not visible in the 1959 photograph and have probably been planted within the last 10 – 20 years.

Onehunga, like many other Auckland suburbs, has experienced a dramatic increase in housing density and industrialisation in the last 40 years. Significant areas of tidal shores have been reclaimed to create more land for industry, and remaining vegetation remnants have been considerably reduced in area. Few areas of freshwater wetlands remain, and most are heavily infested with invasive weeds such as pampas (*Cortaderia* spp.) and willows (*Salix* spp.).

Vegetation

Five distinct vegetation types are present within "The Grotto"; mown grassland, cultivated land, open wasteland, forest, and wetland.

Mown grassland

Fig. 2 shows the main grassland area on the eastern edge of "The Grotto". The common monocot species in mown areas were *Avena sterilis*, *Digitaria sanguinalis*, *Holcus lanatus*, *Paspalum dilitatum*, and *Sporobolus africanus*. *Carex inversa*, *Microlaena stipoides*, *Poa trivialis*, and *Setaria pumila* were occasional, local, or scarce. Dicotyledonous species were also a significant component of mown areas. *Bellis perennis*, *Hypochoeris*

radicata, *Modiola caroliniana*, *Picris echioides*, *Plantago lanceolata*, and *Taraxacum officinale* were common, and *Trifolium repens* was abundant.

Cultivated land

In the north west corner of "The Grotto" is an area of c. 20 m² that is cultivated for vegetables. The main species growing in this area in September 2003 were silverbeet (*Beta vulgaris*), borage (*Borago officinalis*), and rhubarb (*Rheum rhabarbarum*).

Open wasteland

The main area of open wasteland was on the eastern slopes of the collapse pit. This area was dominated by wild oat grass (*Arrhenatherum elatius*), *Bromus willdenowii*, *Holcus lanatus*, *Picris echioides*, nasturtium (*Tropaeolum majus*), and *Ipomoea indica*. Uncommon naturalised or garden escape species in open wasteland areas included *Fuchsia boliviana*, *Ixia maculata*, four o'clock plant (*Mirabilis jalapa*), *Narcissus ?x medioluteus*, and *Ranunculus ficaria* var. *ficariiformis*.

Forest

Chinese privet (*Ligustrum sinense*) forms a low dense canopy on the south and west sides of the collapse pit. Scattered trees of karo (*Pittosporum crassifolium*) and *Coprosma* aff. *macrocarpa* x *C. robusta* were present

and appear to be of natural origin. The understorey was sparse and consists of saplings of the canopy species, as well as occasional juveniles of mahoe (*Melicactus ramiflorus*), mapou (*Myrsine australis*) and shining privet (*Ligustrum lucidum*). Pohuehue (*Muehlenbeckia complexa*) was locally abundant, especially on the southern side of the pit where it ascends the privet to form a significant part of the canopy. Wandering Jew (*Tradescantia fluminensis*)

was a common groundcover on the gentler lower slopes of the pit. Areas of exposed basalt were characterised by cineraria (*Pericallis x hybrida*) and the native ferns *Adiantum hispidulum*, *Doodia australis*, and *Pellaea rotundifolia*. Naturalised or adventive species of note included one holly fern (*Cyrtomium falcatum*), and a juvenile fruit salad plant (*Monstera deliciosa*). The presence of this fruit salad plant was puzzling as it did not appear to have originated as a garden discard, and this find was discussed in further detail by Martin (2002).

The native moss *Hypopterygium rotulatum* was abundant on the lower, densely shaded basalt rock faces, and *Fissidens taxifolius* was locally present on damp shaded ground.



Fig. 1. Aerial photograph of "The Grotto", 1959. Grotto Street runs west – east across the bottom edge of the photograph.

Wetland

The wetland area covers the floor of the collapse pit. Ground moisture was moist to saturated on each visit, and after periods of heavy rain the area can be completely inundated (*pers. obs.*). Fig. 3 shows the different areas of vegetation on the collapse pit floor. The main vegetation type, covering approximately the southern two thirds of the pit, is characterised by *Carex subdola*, tall *Carex secta*, *Calystegia sepium*, and *Paspalum distichum*. The northern edge of the wetland is dominated by a dense stand of *Bolboschoenus fluviatilis*, covering an area of c. 250 m².

Several small pools exist, one in the middle of the pit of c. 50 m² separating the *B. fluviatilis* stand from the *Carex* dominated area, and others on the southern and western edges of the pit. The main pool has a colony of *Isolepis prolifer*, abundant *Lemna minor*, a few stems of *B. fluviatilis*, and *Persicaria decipiens*. The small pools have a dense cover of *Lemna minor*.

Exotic species are noticeably less abundant than in the area surrounding the wetland. Blackberry (*Rubus*



Fig 2. Eastern edge of the area looking towards Grotto Street, March 2003. Left – mown grassland, centre foreground – open wasteland, centre background – old building foundations, right – edge of collapse pit floor.



Fig. 3. Eastern edge of the collapse pit looking west, March 2003. Foreground – old brick wall covered with *Ipomoea indica*, centre left – area dominated by *Carex subdola* and *Paspalum distichum*, centre – main pool, centre right – area dominated by *Calystegia sepium* and *Bolboschoenus fluviatilis*, background – western side of collapse pit dominated by Chinese privet (*Ligustrum sinense*).



Fig 4. Main pool on wetland floor with *Calystegia sepium*, *Carex subdola*, *Paspalum distichum*, and *Lemna minor*. March 2003.

fruticosus agg.) and buttercup (*Ranunculus repens*) were abundant in places, and sea aster (*Aster subulatus*) and dock (*Rumex crispus*) were occasional.

A comparison with other Onehunga wetlands

Table 1 outlines the presence of key species in Onehunga wetlands. The wetland at "The Grotto" is notable for its lack of weeds and the abundance of *Carex subdola*. This sedge is classified as endangered in the Auckland region (de Lange et al. 1999). A survey of the *C. subdola* in November 2003 resulted in a minimum population estimate of 350 plants.

Weeds such as willows (*Salix* spp.) and water celery (*Apium nodiflorum*) that dominate other Onehunga

wetlands are absent, and the exotics that are common (*Paspalum distichum*, *Rubus fruticosus* agg.), do not appear to significantly impact on the natural character or ecological values of the area.

In contrast to Captain Springs Reserve and Bycroft Springs, where flowing water is present, "The Grotto" is characterised by the presence of small pools with no noticeable water flow (Fig. 4). The pools are ill defined, and during the winter months when the ground is particularly water logged, there are areas of gradual transition from dry ground to open water. The peaty substrate of the wetland appears to be unusual for the Onehunga area.

Table 1. Distribution of selected species in three Onehunga wetlands

SPECIES	THE GROTTTO	BYCROFTS SPRINGS**	CAPTAIN SPRINGS**
<i>Apium nodiflorum</i> *		X	X
<i>Bolboschoenus fluviatilis</i>	X		X
<i>Carex secta</i>	X	X	X
<i>C. subdola</i>	X		
<i>C. virgata</i>		X	
<i>Cortaderia</i> spp. *		X	X ^M
<i>Isolepis prolifer</i>	X		
<i>Lemna minor</i>	X		X ^M
<i>Persicaria decipiens</i>	X	X	X ^M
<i>Salix</i> spp. *		X	X
<i>Schoenoplectus tabernaemontani</i>		X	
<i>Typha orientalis</i>		X	X

X = species present, * = naturalised species, ** = surveyed by Gardner (1994), X^M = additions to Gardner (1994) by Martin 2003.

Present management

The mown grassland areas are mown throughout the year at intervals of c. 1-2 months. The wasteland areas and the collapse pit floor are unmanaged, with the exception of the presumed planting of the *Acer negundo*, the *Pinus radiata* saplings, and flax (*Phormium tenax*).

The future of "The Grotto"

The future of the area is uncertain. The area appears to be in private ownership and the survival of this area is reliant on the continuation of the current 'hands off' management style. The wetland itself is partially protected from development due to its' waterlogged soils and tendency to flood. However, significant damage would result if a different management style was adopted, for example additional plantings, or 'weed' control within the wetland area. Species such as

Carex subdola could easily be lost and this would constitute a substantial loss to the local flora.

The area is a local botanical treasure and needs to have its' protection ensured. The greatest need for the area is to have it legally protected and undertake selective weed control. Sufficient indigenous diversity is present to colonise sites left open by weed control, and minimal planting would be necessary. The surrounding mown grassland could be maintained as open space to allow views over the wetland, or restored as coastal forest. The area could also function as an educational resource for the local community with interpretive signs explaining the botanical and geological features. With its contrasting landscape features and interesting botany "The Grotto" would make the perfect complement to the other wetland reserves in Onehunga.

Acknowledgements

Ewen Cameron, John Braggins, David Galloway, Peter de Lange, Rhys Gardner, Jessica Beever and Peter Johnston all identified specimens from "The Grotto". Ewen Cameron provided valuable comments on the draft. Thank you for your time and encouragement.

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Appendix 1. Species list for "The Grotto", Onehunga.

Key

a	abundant	*	adventive
c	common	AK	Auckland Herbarium
o	occasional		
l	local		
s	scarce (<5 seen)		
x1	only 1 individual seen		
j	juvenile		
p	planted		
BF	building foundations	OW	open wasteland
RF	rock faces	PW	permanent water
F	forest	CPF	collapse pit floor
MG	mown grassland	W	walls
CL	cultivated land		

	Habitat	Abundance	Voucher (AK)
Ferns and fern allies (5 + 1)			
<i>Adiantum hispidulum</i>	F	l	258373
<i>Cyrtomium falcatum</i> *	F	s	258371
<i>Doodia australis</i>	F	l	258372
<i>Pellaea rotundifolia</i>	F	o	258374
<i>Pteris tremula</i>	W	l	284365
<i>Pyrossia eleagnifolia</i>	F	s	284367
Gymnosperms (1 + 1)			
<i>Pinus radiata</i> *	OW	x2, j, p	
<i>Podocarpus totara</i>	F	x1, j	284362
Dicots (9 + 68)			
<i>Acer negundo</i> *	CPF	s, p	
<i>Acmena smithii</i> *	F	a	
<i>Anagallis arvensis</i> subsp. <i>arvensis</i>	MG	o	
<i>Araujia sericifera</i> *	F, OW	c	
<i>Aster subulatus</i> *	CPF	c	
<i>Bellis perennis</i> *	MG	c	
<i>Beta vulgaris</i> *	CL	l, p	
<i>Borago officinalis</i> *	CL	l, p	
<i>Buddleja davidii</i> *	BF	s	
<i>Calystegia sepium</i>	CPF	a	280670
<i>Cardamine hirsuta</i> *	W	x1	
<i>Coprosma</i> aff. <i>macrocarpa</i> x <i>C. robusta</i>	F	c	258671
<i>Cotoneaster lacteus</i> *	F	x1	
<i>Crassula multicava</i> *	F	l	

<i>Dichondra repens</i>	F	l	
<i>Duchesnea indica</i> *	F	l	
<i>Eriobotrya japonica</i> *	W	s, j, p?	
<i>Erodium moschatum</i> *	OW	x1	
<i>Euonymus japonicus</i> *	F	o	
<i>Euphorbia peplus</i> *	BF, MG	o	
<i>Foeniculum vulgare</i> *	OW	c	
<i>Fuchsia boliviana</i> *	OW	x1	258254
<i>Fumaria muralis</i> *	BF	o	
<i>Galium aparine</i> *	W	o	
<i>Geranium molle</i> *	BF, MG	l	
<i>G. dissectum</i> *	BF	o	
<i>Hedera helix</i> *	F	s	
<i>Hypochoeris radicata</i> *	MG	c	
<i>Ipomoea indica</i> *	OW, F, BF	c	
<i>Jasminum officinale</i> *	BF, OW	s	
<i>Lantana camara</i> *	F	l	
<i>Ligustrum lucidum</i> *	F	s	
<i>L. sinense</i> *	F	a	
<i>Lonicera japonica</i> *	F	s	
<i>Malva sylvestris</i> *	BF	s	
<i>Mecurialis annua</i> *	OW	l	
<i>Medicago arabica</i> *	MG	o	
<i>M. nigra</i> *	OW	s	
<i>Melicytus ramiflorus</i>	F	s	284363
<i>Mirabilis jalapa</i> *	W	x1	280667
<i>Modiola caroliniana</i> *	MG	c	
<i>Muehlenbeckia complexa</i>	F, OW, CPF	c	280668
<i>Myrsine australis</i>	F	o	283954
<i>Oxalis pes-caprae</i> *	OW	o	
<i>Paraserianthes lophantha</i> *	OW	s	
<i>Pericallis x hybrida</i> *	RF	l	
<i>Persea americana</i> *	OW	x1, j, p?	
<i>Persicaria decipiens</i>	CPF, PW	c	258672
<i>Phaseolus ?vulgaris</i> *	CL	l, p	
<i>Picris echioides</i> *	OW, MG	c	
<i>Pittosporum crassifolium</i>	F	c	258375
<i>Plantago lanceolata</i> *	BF, MG	a	
<i>Portulaca oleracea</i> *	MG	L	
<i>Prunella vulgaris</i> *	MG	a	
<i>Psidium cattleianum</i> *	F	s, j	258253
<i>Ranunculus ficaria</i> var. <i>ficariiformis</i> *	OW	L	257545
<i>R. repens</i> *	CPF	a	
<i>Rheum rhabarbarum</i> *	CL	l, p	
<i>Rubus fruticosus</i> agg. *	CPF, F	c	
<i>Rumex crispus</i> *	CPF, MG	o	
<i>Salix matsudana</i> 'Tortuosa' *	OW	x1	
<i>Senecio mikanoides</i> *	OW, F	o	
<i>S. vulgaris</i> *	W, MG	l	
<i>Solanum nigrum</i> *	OW	s	
<i>S. mauritianum</i> *	F, OW	o	
<i>S. tuberosum</i> *	CL	l, p	
<i>Sonchus oleraceus</i> *	W, MG	o	
<i>Stachys arvensis</i> *	OW, MG	s	
<i>Stellaria media</i> *	W	x1	
<i>Taraxacum officinale</i> *	MG	c	
<i>Tecomaria capensis</i> *	OW	l	
<i>Trifolium repens</i> *	MG	a	
<i>Tropaeolum majus</i> *	OW	a	
<i>Veronica persica</i> *	W	x1	
<i>Vicia</i> sp. *	F	x1	

*Vinca major** F, OW I

Monocots (10+30)

<i>Agapanthus praecox</i> *	F	I	
<i>Allium triquetrum</i> *	OW, F	c	
<i>Alocasia brisbanensis</i> *	OW	I	
<i>Amaryllis belladonna</i> *	OW	x1	
<i>Arrhenatherum elatius</i> *	MG	c	
<i>Asparagus asparagoides</i> *	F	o	
<i>Bromus willdenowii</i> *	OW	c	
<i>Bolboschoenus fluviatilis</i>	CPF	a	258670
<i>Canna indica</i> *	OW	I	
<i>Carex divulsa</i> *	F	I	
<i>C. inversa</i>	MG	o	
<i>C. secta</i>	CPF	c	280674
<i>C. subdola</i>	CPF	c	280673
<i>Cordyline australis</i>	CPF	I	284364
<i>Cortaderia selloana</i> *	OW, F	s	
<i>Crocasmia x crocosmifolia</i> *	OW	I	
<i>Cyperus eragrostis</i> *	CPF, MG	I	
<i>Dactylis glomerata</i> *	OW	o	
<i>Digitaria sanguinalis</i> *	MG	c	
<i>Ehrharta erecta</i> *	F, CPF	o	
<i>Hedychium flavescens</i> *	OW	s	
<i>H. gardnerianum</i> *	F	o	
<i>Holcus lanatus</i> *	OW, MG	c	
<i>Isolepis prolifer</i>	PW	a	258713
<i>Ixia maculata</i> *	OW	s	
<i>Juncus sarophorus</i>	CPF	x1	
<i>Lemna minor</i>	PW	a	284368
<i>Microlaena stipoides</i>	MG	s	280671
<i>Monstera deliciosa</i> *	F	x1	258255
<i>Musa sp.</i> *	F	s	
<i>Narcissus ?x medioluteus</i> *	OW	I	
<i>Paspalum dilitatum</i> *	MG	c	
<i>P. distichum</i> *	CPF	a	
<i>Phoenix canariensis</i> *	F	x1	
<i>Phormium tenax</i>	CPF	I	
<i>Poa trivialis</i> *	MG	s	
<i>Setaria pumila</i> *	MG	o	
<i>Sporobolus africanus</i> *	MG	c	
<i>Tradescantia fluminensis</i> *	F	a	
<i>Zantedeschia aethiopica</i> *	OW, F	I	

Bryophytes (under recorded) (7+ 2)

<i>Chiloscyphus sp.</i>	CPF		
<i>Fissidens taxifolius</i> *	F	I	258577
<i>Frullania sp.</i>	F		258603
<i>Hypopterygium rotulatum</i>	RF	a	258575
<i>Lunularia cruciata</i>	W	o	
<i>Metzgeria sp.</i>	F		258576
<i>Paniera sp.</i>	RF	a	
<i>Stokesiella praelonga</i> *	CPF	I	
<i>Tortula sp.</i>	W	o	

Lichens (under recorded) (4)

<i>?Dirina sp.</i>	OW		
<i>Hyperphyscia adglutinata</i>	F		258606
<i>Ramalina celastri</i>	F		
<i>Teloschistes chrysophthalmus</i>	OW		

FUNGI (under recorded) (1 + 1)

<i>Hypocrea</i> sp.	F	I
<i>Trametes versicolor</i> *	F	I

Lichen Ramble

Rick Kooperberg

On the morning of the 16th October a group of about fifteen eager "lichenologists" gathered at the Auckland Museum to learn more about our much overlooked lichens.

The foray was lead by Dr. David Galloway, who had presented the Lucy Cranwell lecture the previous evening. David is the author of the New Zealand Lichen Flora (1985) and is now working on the final stages of a new Lichen Flora that will be published by mid 2004. David works at Landcare Research in Dunedin and for the curious his visit was a golden opportunity to learn about lichens.

Even before we left the museum's shadow David had drawn our attention to five lichens, each thriving in its own habitat:

Xanthoria parietina, a brilliant orange in the most exposed position. *Xanthoparmelia scabrosa* closely attached to the asphalt and surviving considerable traffic. On the mortared wall we found the calcareous loving lichens: *Lecanora dispersa*, the little black *Acrospora* sp. and the egg yolk yellow coloured *Candelariella* sp.

We then looked at the bark of a nearby pohutakawa, here the predominant lichen was *Heterodermia speciosa* with some patches of *Dirinaria applanata*. These two lichens are often seen together. The first has long narrow lobes with its powdery soredia (vegetative propagules) abundant along the edges of the older lobes. The second also forms large patches when individuals become crowded but its short lobes merge together and may appear pleated. Its soredia

are produced in spherical soralia that sometimes look quite bluish.

In the dryer areas on the underside of some branches we found the bright yellow leprose lichen *Crysothrix candelaris* and scattered over much of the remaining bark, like punctuation marks, were the little black apothecia (sexual reproductive structures) of the crustose (crusty) lichen *Amandinea punctata*. Another crustose lichen without any visible thallus was also there, *Dictyographa cinerea* was only detectable by its shiny black (carbonised) apothecia that were like miniature grains of wheat.

Moving on to some young ash trees we were introduced to a few more crustose species. We saw *Lecanora flavopallida*, *Pertusaria sorodes* and the distinctive *Opegrapha* sp. with its elongated apothecia shaped like strange lettering. These trees had some more leafy (foliose) lichens: *Parmotrema chinense* and its more common look-alike *Rimelia reticulata*, also *Punctelia borreri* with little white "pin prick"

pseudocypbellae (openings in its upper cortex). We found *Parmelina labrosa* which has large lip-like soralia. On one branch there were dark yellow *Xanthoria parietina* on its upper surface and yellow-green specimens on the underside showing just how this lichen's colour depends on its exposure. On a fallen branch we found the delicate fruticose (shrubby) lichen *Teloschistes chrysophthalmus* this has a similar colour range to *Xanthoria parietina* but can be easily overlooked as it prefers to live on twigs and small branches high in the tree. Two other fruticose lichens



Homage to lichens: Left to right, Mike Wilcox, John Braggins, Pauline Low, Ewen Cameron, Rick Kooperberg and David Galloway (kneeling). Photo by Enid Asquith.